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ABSTRACT

This paper presents the course outline of a methods course for elementary education majors that is based on the structure of the Florida Sunshine State Standards pertaining to science. This structure provides education majors with the vertical scope and sequence of public school science education. The focus is on pedagogical knowledge beyond the type of information obtained in science content courses taken by students during the first two years of undergraduate study. A student assessment of the course and instructor comments is provided. (DDR)

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A Science Curriculum Foundations course for Elementary Education Majors

by
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A Science Curriculum Foundations Course for Elementary Education Majors

Introduction

There is increasing concern among the general public that science education in elementary schools needs improvement (Hirsch, 1996). Directly related to this concern is the evidence that current university undergraduate students of elementary school education do not have a proper understanding of the science content which should be included in the elementary school curriculum to prepare children for higher learning in science in middle and secondary school (Bradley, 1997).

In Florida, the Department of Education has developed a set of standards for each subject area, the Florida Sunshine State Standards (1996). These standards in the science content area reflect standards developed at the national level by the National Research Council (1996). In January, 1997, the Nova Southeastern University (NSU) Department of Undergraduate Education decided to develop a science curriculum foundation course to be a precursor to the established course concerning methods of teaching science in elementary school. NSU undergraduate students in elementary education would take this new course at the beginning of their junior year of study as a required course in their major. The new course needed to be included in the junior year of study because many students transfer to NSU at the beginning of their third academic year.

This report provides a description of the course outline which is based upon the structure of the Florida Sunshine State Standards pertaining to science. This structure provides education majors with the vertical scope and sequence of public school science education (preK-12). This is pedagogical knowledge beyond the type of information obtained in science content courses which the students may have taken during their first two years of undergraduate study. Following the description of the course is an assessment by students who took the course in its first offering, in the fall of 1997. Finally, the instructor (and author of this report) comments on knowledge gained through experience in offering this course for the first time, knowledge to be used in future planning.

The Course Outline

The undergraduate education courses at NSU run on an eight week cycle. The science curriculum foundations course was based on studying eight general science topics, one topic per week. This eight topic format utilized the eight learning strands developed for science education in the Florida Sunshine State Standards (Table 1).

The method of exploring each strand on a weekly basis focused on selecting a sampling of the benchmarks defined within each strand. The selected benchmarks stated in the course outline demonstrated the vertical scope and sequence of the science curriculum (preK-12). The students would experience the developmental connections among the science concepts in the benchmarks and gain understanding about the science concepts which needed to be learned during elementary school as a foundation for future science learning at higher grade levels. Each science strand in the Florida Sunshine State Standards is a learning pathway linking particular science subjects which children are able to comprehend during the elementary school years with the science concepts the children would eventually study in middle and secondary schools.

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Table 2 shows one strand and the sample benchmarks contained in that strand which were discussed during one week in the science curriculum foundations course.

The necessity of identifying and understanding approximately a dozen related concepts per week proved to be a challenge during the course. Many of the concepts required abstract cognitive study which precluded extended hands-on, material-based exploration of each benchmark. The most frequently used resources were public school science textbooks and related multimedia, i.e., videos, CD-ROMs, and the Internet. In class, the students received a concise introduction to each strand at the beginning by the instructor. They were then organized into cooperative learning groups to explore subsets of the benchmarks for the particular week. Members of each cooperative group then prepared one-page information sheets about the benchmarks assigned to their group. The information sheet for each benchmark (example: Table 3) was copied for every member of the class and distributed at the point in class when individuals of every cooperative group reported to the whole class what information had been gathered about each benchmark. The compilation of these information sheets created a journal for each student which was a permanent record of the exploration of the sample benchmarks. It would hopefully serve as a useful resource to these future teachers as to what science content they should include in their lesson plans whichever grade they eventually teach in elementary school.

The class was given a written test on a bi-weekly basis in which they were asked to present in short essay form their knowledge of selected benchmarks which had been studied over the previous two weeks. Four tests over the eight week duration of the course were averaged and formed the basis of their final grade. Class attendance, preparation of information sheets on benchmarks, and individual presentations to class were requirements of the course. Lack of attendance or poor contribution to the class efforts by any student detracted from an individual's final grade.

The required texts for the course were the National Research Council's National Science Education Standards (1996) and the Florida Sunshine State Science Standards (1996). These texts provided an outline of the science content to be studied but not an elaboration of subject matter. In order to provide science information for classroom group discussion, a set of science textbooks representing subject matter at all grade levels (preK-12) was obtained as a donation from the Broward School Board, Ft. Lauderdale, FL. These books not only provided ample information on all topics explored in class, but also provided exposure to the texts currently being used in the public school system. Outside of class, students sought information from multimedia which they also included in their benchmark information sheets and classroom presentations.

There was a determined effort by the instructor to refrain from being a focal point of information about the science topics explored each week. Students were assisted in group by the instructor in a facilitating manner guiding students to sources of information augmented by an occasional video pertaining to a current strand. There were no lectures by the instructor, and questions raised in class on science content came from students during group discussion and at the summary presentations to the class.

The Students' Assessment of the Course

The following is an unabridged report of the written comments of the fourteen students composing the class who were asked to assess this course in its first offering.

Question 1. What were the strengths of this course?

Student Responses:

1. Group activity in gathering information to present in class

2. The strength of the course was researching the information on the particular benchmark. This provided the students w/ a better understanding of the subject discussed.

3. Helped me to stand and present material to the class

4. Taking different books home, searching information from different sources were the strengths that I particularly benefitted from. I learned more than I expected to learn in this class.

5. (No response)

6. (No respnse)

7. Keeping a journal with the benchmarks will help us to teach the sunshine standards in the future!

8. (No response)

9. The strengths were the presentations given by classmates. We had practice in front of a group (speaking).

10. Not many. Dr. Stetter is an excellent instructor yet, this course left more than a bit to be desired

11. I found the strength to be the fact that we were reviewing our science knowledge, and that we had to speak in front of the class.

12. I like the set up of everyone finding the info. And sharing it. It models the way we will need to teach our students in the future.

13. Personally I found this course extremely helpful to me. I was reinforced in a lot of science concepts that I had forgotten over time. It also gave me a greater understanding, as an adult, of the importance of scientific concepts.

14. The instructor gave us essay question tests which obligated us to have a better understanding of the material.

Question 2. How could this course be improved?

Student Responses:

1. A textbook with more information for the use in class.

2. (No response)

3. Teacher could teach a little more.

4. It was a different approach to learning. I personally think that the approach was good and I would recommend it to anybody.

5. Having the teacher get a better method of going about the instruction.

6. A better teaching method could probably improve this course!

7. This class was very redundant and mundane-each week was basically repeated itself throughout the semester-students should get some credit for class participation to help test scores + about half way through course, need to change procedures to more hands-on

8. Teacher could help by explaining benchmarks before we do our presentation

9. Have more materials available to us for research.

10. Not having such detailed tests. Average teacher, required to memorize all details of all subjects. I think not. If yes, than why do I take courses that involve lesson planning.

11. (No response)

12. I wish that we had had some of the methods books available during the course. There was a lot of good info in them about many of the benchmarks we expand.

13. The NRC textbook was never used and it is not necessary to purchase for this class.

14. Most of the shades/blinds in the classroom should be open because if the class is about science and our environment, we should always be in harmony with the environment. It is a great blessing to let the sunshine in the classroom and to be able to see the trees because we take these things for granted.

Instructor's Commentary

I will certainly open up the shades and let the sunshine in. Also, I was gratified that the majority of the class reported finding the course beneficial in improving their knowledge of science content and in placing that content in a curriculum framework. The students finished the course with a better overview of the science content which needed to be learned in elementary school and a better understanding of why that particular content needed to be learned as a foundation for future study at higher grade levels. This was the objective of the course.

The comments on the methods by which the students were asked to learn this subject matter are important reminders that not all undergraduate students today feel comfortable with the concept of student-centered learning. Some students, it is evident, would have preferred to receive a lecture on each benchmark or to have spent more time exploring the elementary science benchmarks with hands-on activities in class rather than by literature-based research.

Taking into consideration the amount of information which needed to be explored and assimilated which included knowledge studied at the secondary school level, I believe the class learned by the most efficient method. The students understood the science better by researching it themselves and putting the information down in essay format on their benchmark information sheets. They covered more benchmarks across all the grades (preK-12) by deriving information from printed and electronic sources than would have been possible by hands-on activities alternatively.

For those students with a desire for activity-based learning, the second course in their curriculum concerning science education, methods of teaching science in elementary school, devotes a large portion of class time to student presentations of lesson plans exploring science topics specific to the elementary curriculum utilizing hands-on, activity-based techniques in a cooperative learning group format.

The comments concerning the usefulness of the prescribed texts initially used in this course have raised some concern about the need for two texts both directed at explaining the outline of the science curriculum. Because of the course structure, the more useful publication was the Florida Sunshine State Science Standards booklet. The National Research Council text received much less attention. In the future I am considering using simply the Florida publication plus the text which the students would eventually use in the second course pertaining to methods of teaching science. This latter publication contains a large amount of science content in line with the Florida science strands.

Conclusion

The comments by the students who took this course confirms the need for this science curriculum foundation course in the elementary education degree program. The knowledge and understanding of science content must precede the study of methods to teach that science content. There is a deficit of science knowledge among many undergraduate education students today which requires a formal course offering in their education major curriculum. This report is offered in the hope that other colleges and universities in Florida will consider augmenting their present elementary education curriculum to include such a course.

Table 1.

A listing of the eight learning strands in the Florida Sunshine State Science Standards.

Strand A.	The Nature of Matter
Strand B.	Energy
Strand C.	Force and Motion
Strand D.	Processes that Shape the Earth
Strand E.	Earth and Space
Strand F.	Processes of Life
Strand G.	How Living Things Interact With Their Environment
Strand H.	The Nature of Science

Table 2.
A sampling of benchmarks from one of the learning strands in the Florida Sunshine State Science Standards

Strand A. The Nature of Matter

Benchmarks Discussed:

SC.A.1.1.1	Classify objects by their physical properties
SC.A.1.1.2	A particular substance can exist in different states
SC.A.1.2.2	Substances can be changed from one state to another
SC.A.1.2.5	Compounds have different properties from their original elements
SC.A.1.3.3	Temperature measures the energy of motion of particles
SC.A.1.3.5	The difference between a physical change and a chemical change
SC.A.2.3.2	The subatomic configuration of atoms
SC.A.2.4.5	The Periodic Table
SC.A.1.4.4	Concentration, pressure, and temperature, re., chemical reactions
SC.A.1.4.5	Covalent, ionic, and electrostatic chemical bonds
SC.A.2.4.6	Electrons as particles and waves

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Table 3.

A sample benchmark information sheet generated in group acitivity during the course.

Benchmark SC.A.1.3.3: Temperature measures the energy of motion of particles

Grade Level: 6 - 8

Science Vocabulary:

1. Kinetic energy: Energy of motion
2. Potential energy: Stored energy
3. Temperature: The measure of heat energy in a substance
4. Thermometer: Device used to measure temperature

Content:

There are two forms of energy: kinetic energy and potential energy. Moving objects have energy. The energy emitted from these objects is called kinetic energy. We can measure the kinetic energy in objects by their temperature. The temperature is a measure of the average kinetic energy of the molecules. On the other hand, potential energy is found in objects which are not in motion, and therefore cannot be measured by temperature.

Most substances are likely to expand when their temperature is increased. As the result of energy of motion the particles in a substance will tend to move away from each other. The higher the temperature is raised, the faster the molecules in a given sample are moving. Therefore, as kinetic energy increases, so does its temperature. Temperature is measured in units called degrees Fahrenheit, degrees Celsius or degrees Kelvin.

Content Development:

By methods of experimentation and questioning, students gain a better understanding of the benchmark.

1. Ask students to give examples of kinetic energy in their daily lives.
2. Use a drop of dye in bottles of water at different temperatures and observe the speed of dissolving compared to each water bottle's temperature.

Questions:

1. What examples would you as a teacher give to show students that there are many forms of kinetic energy around them?
2. What other methods can you use to demonstrate that as kinetic energy increases, so does its temperature?

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